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# ORGANIC COLOR.

BY F. T. MOTT, F.R.G.S., LEICESTER, ENGLAND.

THE colors of plants and animals may be due (1) to diffraction and interference from striated surfaces, as in some iridescent feathers and shells; or (2) to pigments whose function seems to be especially to give color; or (3) to the molecular structure of the tissues themselves.

The first of these causes is not a physiological phenomenon. It can be equally well exhibited by artificial means. The second and third are phenomena connected with the most fundamental elements of organic life.

The colors of tissues or pigments depend, of course, upon the portion of white light which is reflected from them. The white light of the sun falling upon an object is in all cases partly absorbed and partly reflected. This "light" is merely a series of undulations or ripples running through the ether, the ripples being of various sizes; and the color of the object depends altogether upon the quantity and the size of the ripples which are stopped or absorbed. The cause of the differences in color among various organic objects must lie in the varying power of absorption possessed by the tissues. The petals of a pink rose absorb the undulations of medium size, and reflect both the larger and smaller ones; while the petals of a scarlet geranium absorb the small undulations, reflecting only the medium and larger ones. But why should this difference exist in the absorbing power of the flowers?

Here is the *crux*, which is still a crux in spite of the much-lauded hypothesis of insect selection. Insect selection may account for something, but there is much more for the explanation of which it is quite unavailable. The supposed all-sufficiency of this hypothesis is completely answered by the fact that insect selection cannot come into play at all in the production of color until the plant has already shown its power to produce that particular color quite independently of insects. It is evident that the color is due not to insects, but to some inherent capacity of the plant, and that a plant which could produce a small pink petal could equally well produce a large one under suitable conditions. The utmost that can be claimed for insect selection is that it may accelerate the production of the large and showy petals by giving to the plants which show their tendency to produce such petals better opportunities of developing that tendency. The crucial question remains, What is it which gives to a plant this tendency to produce colored petals?

There are two fundamental laws of nature which, in the attempts to solve this question, have not been sufficiently regarded, viz., (1) the law of the concentrating wave, and (2) the law of sympathetic vibration. By studying the action of these laws, it seems possible to carry the solution at least one step further back from the position in which it now stands.

We are familiar with the simple wave of oscillation, as in the pendulum; and also with the wave of undulation, as in sound, light, and the spreading rings upon the surface of water; but the wave of concentration is less familiar to us, and has been less carefully studied.

All organisms are illustrations of this particular wave-form. As the kinetic energy of the swinging pendulum increases as it approaches the centre of its curve, and then again diminishes, so the energy of the organism increases as it approaches the climax of its life, and then diminishes. But, while the swing of the pendulum is a simple process, involving merely the alternate change of form of a given amount of energy, the growth of an organism is almost infinitely complex. The accumulation of energy which this growth represents takes place slowly and intermittently by the drawing-in of outlying units to a centre, the energies of these units being aggregated and assimilated to the forms of the original germ. This accumulation of energy continues, if not violently interrupted, until a certain definite degree of concentration is attained, after which a gradual dispersion of the energy sets in until the organism dies of old age. All organic individuals have a limited period of life, and pass through a similar series of periodic changes, gradually attaining a climax of concentrated energy, which is afterwards gradually dissipated. The ascending and descending phases of the wave are rarely equal, but probably always equivalent. One may be long and slow, the other short and rapid, or *vice versa*. The variations in this equivalence may be almost infinite.

It is clear that this law of the concentrating wave controls the life-history of every individual. It is not so demonstrable, but is, nevertheless, highly probable that the same law controls the development of species, genus, order, and class, and is, in fact, the fundamental law of the unfolding universe, at all events, of the organic phase of it.

What is the relation of this law to organic color?

Let us assume the general correctness of the molecular theory as the nearest approach which science has yet made to an explanation of the structure of matter.

Throughout all substances in which the temperature is above the point of absolute zero, as in all living organic substances, the molecules must be in continual motion. But, being linked together by powerful "affinities" (whatever these may be) into definite groups, and in all solid bodies packed very closely together, their motions cannot be altogether free. There must be certain directions in which they can move, and certain others in which they cannot move; and the group of motions possible to them will differ in each compound chemical substance. There will be a definite group of motions possible to the molecules of albumen, another to those of starch, etc. There will also be a definite but more complex group of motions possible to the totality of molecules which make up each kind of tissue, as skin, muscle, bone, nerve, etc., and a still more complex group possible to those which make up each organic individual. This characteristic grouping of possible motions may be called *molecular rhythm.*

One of the specific functions of organized matter is that of assimilation and growth. There is no organism which can assimilate matter of every kind. The power of selecting food depends upon the molecular rhythm of the organism. Substances whose molecules have possible motions which harmonize with those of the feeding organism can be assimilated and made to add their energies to the stock of that individual, causing it to "grow" in size and in accumulated energy. Substances whose molecular rhythm will not allow of such assimilation are not available as food for that organism.

The organism continues to feed, to assimilate, and to grow, in accordance with the law of the concentrating wave up to a certain point, but there is a limit which it cannot pass. Having reached that limit, concentration ceases and dispersion sets in. What determines that limit?

The phenomenon of growth is not a passing function, not a mere reception and assimilation of energy. Every organism is more or less active and parts with energy as constantly as it receives it. Growth is the result of the balance between these two processes. As long as the organism assimilates more energy than it dissipates by its various activities, growth continues.

The limiting-point is that epoch in life at which assimilation becomes so small as to be overtaken by the dispersion. But what diminishes the power of assimilation?

The molecular rhythm of any organism is necessarily of limited compass. In the embryo only the main chords are struck; the molecular motions are comparatively free, and some amount of modification is then possible. But, as the intervals are filled up by the harmonious motions of the assimilated molecules, the rhythm becomes fuller and, at the same time, more fixed, till a point is reached at which little more permanent assimilation is possible. This is the climacteric of the life of that organism. The limit is determined by the original outlines of the molecular rhythm in the embryo, slightly modified by the amount and the quality of the food assimilated during growth.

We have now to consider the action of the law of sympathetic vibration on the growing organism.

A tightly stretched wire may be made to give out a musical note by sounding near to it a certain note on a violin. The group of vibrations produced in the violin is communicated to the air, and the air communicates it to the stretched wire. It can only do this if the condition of the wire is such as to make that group of vibrations possible to it. If only some part of the group is possible to it, it may take up that part and reject the rest. This is a case of molar, not of molecular, vibration, but the same law operates in the case of the molecular vibrations of radiant heat and light, which are communicated through the ether. Such of these vibrations as are possible to some of the molecules of the substance receiving them will be absorbed, while the rest will be transmitted or reflected. The energy of those vibrations which have been absorbed will go to increase the amplitude of the vibrations by which they have been assimilated. They do not, as in the case of food, introduce fresh molecules with harmonic vibrations which occupy vacancies in the established rhythmical system, but they give increased force to certain existing vibrations, and thus alter the balance of forces in the established system. The vibrations so reinforced will acquire a more or less controlling influence throughout the total group, and there will be a tendency among the vibrations of less energy to fall gradually into the swing of these controlling vibrations. Thus the molecular rhythm of the total group may become modified within certain narrow limits by the light in which the organism lives, if that influence is continued for a sufficiently long period, as well as by the food which it assimilates.

It is evident that the tendency of the action of these two laws — the law of the concentrating wave and the law of sympathetic vibration — must be to enhance the energy of the original molecular rhythm of the embryo, to make it fuller, richer, more definite, and less capable of further modification as it approaches its climacteric, while, at the same time, it is simplified and cleared of a number of vibrations differing only slightly from the controlling ones, by the bringing of these gradually into unison.

The bearing of these results upon organic color remains to be discussed.

It is a well-known physiological rule, with possibly a few exceptions, that organisms in their embryonic and early stages are less brightly colored than they afterwards become. This is plainly seen in the young of birds. Germinating seeds are nearly always of a dull white, which means that about an equal, though small, quantity of every vibration in the sunlight is able to be absorbed. The color of the first leaves is the primary green, indicating that the plant, while able to absorb a larger proportion of the white light, is becoming less able to absorb the vibrations of medium size. As the foliage becomes developed, varied tints of green, with some reds and dull purples, are reflected, showing that there is a still less varied capacity for absorbing. Finally, in the blossom of the higher orders of plants, of which the color is nearly always some shade of the brilliant secondary hues, scarlet, orange, yellow, blue, or rose, it is evident that a great simplification of the molecular rhythm has taken place, so that the absorption is chiefly confined to one group of the light-vibrations, while large proportions of the other two are reflected.

This process of simplification in the molecular rhythm, as the concentrating organic wave approaches its climacteric, may be traced in various phases of vegetable and animal life. In a flowering tree or shrub there are three great systems of structure, viz., the stem and branches, the foliage, and the inflorescence; and these represent three stages of advancing development and vitalization. The color reflected by the system which stands lowest in the scale, the stem and branches, is generally dull green, brown, or plum, indicating that nearly all the light which reaches them is absorbed. In the uniform green of the foliage a certain amount of simplification is shown; and in the brilliance of the inflorescence we see the greatest simplification attainable by that species.

Those families of plants in each great class which have the lowest organization display, as a rule, the least color. The Coniferæ represent the earliest type of existing trees, and are nearly all sombre in coloring. The Amentiferæ stand next, and, though brighter in foliage and much more varied, do not attain to colored blossom. The numerous orders of "flowering" trees and shrubs are of most recent origin, and represent the highest phase of development in the great concentrating wave of vegetable life. The fern form is a very ancient one, and has never, even to the present day, developed much in the way of color. But, if it be true that the recent Monocotyledons are derived from the ferns, they may represent the simplified condition of the fern wave, and among them are many of our most brilliant flowers. The Fungus form must probably be an ancient one also, and among recent Fungi many brilliant hues are developed, which can have no connection with insect choice.

In the large class of birds, the Ratitæ (ostrich, emeu, rhea, cassowary, and apteryx) are the nearest to the reptilian type, and are all dull in color, with the exception of the head of the cassowary, which may have a special explanation. The gulls and albatrosses, which seem to stand next in order of development, are brighter in plumage, but with very little trace of the secondary hues. Brilliant color is almost confined to the more recent insessores.

Among mammals, the early types of elephant, rhinoceros, hippopotamus, hog, etc., are quite without color, while the Carnivora and the Ruminantia, more characteristic of the present epoch, have developed some warmer tints. The Mammalia, as a whole, however, constitute the most recent of the great classes, and it has not yet reached the stage of brilliant coloring. On the other hand, the Mollusca are extremely ancient, and among existing Mollusks a large number display the most brilliant coloring in all the secondary hues.

The final result of the foregoing argument is that the gradual development of organic color is a physiological necessity; that brilliant coloration is a mark of the maturity of some organic force-wave, in which the molecular rhythm has reached its maximum simplification; and that the effect of insect selection in the development of colored flowers is comparatively small.

The very curious appearances of mimicry, which are often supposed to be protective, but of which a large proportion seem to have no such function, may probably be attributed to sympathetic communication of the vibratory motions, which must be passing through the ether in all directions in the neighborhood of organic life.

An animal which spends its life in proximity to the brown bark of trees will be under the influence of the molecular rhythm of such bark, and may have its own molecular rhythm gradually modified by sympathetic action, or it may entirely resist such modification according to its fundamental molecular structure.

The possibility of sympathetic modification of weaker vibrations by a more energetic one, with which they are nearly synchronous, is clearly suggested by the action of a sensitive flame, which, while it is unaffected by vibrations which are palpably discordant, shows itself sensitive to such as are nearly, but not quite, in unison with it. An organism differs from a flame, as from a fixed string or a tuning-fork, in the fact that it is constantly growing, and the added molecules supply material which may be easily amenable to modification.

If the hypothesis here described should be found to explain satisfactorily the phenomena of organic color, the corollaries to be deduced from it will be far-reaching and of much interest, and will apply to beauty of form as well as to brilliance of color.

The world in its early stages must have been sombre and un-

lovely. The forests of the coal period, when the great Sycopods were at their climax, may have exhibited some brighter greens, with tendencies towards yellow or glaucous tints; the shells of the Amonites, in the Liassic seas, may have been colored to some extent; but the great concentrating wave of organic life in its progress towards an unknown climacteric must yield an ever-increasing glory of color and form to the surface of this planet.

The beauty of summer as we know it now, though it has never been paralleled in the past, will be as nothing to the blaze of brilliance which shall mark the summers of the future.

## MINOR PHONETIC ELEMENTS OF MAYA HIEROGLYPHS.

BY HILBORNE T. CRESSON, M.D., PHILADELPHIA.

THE Maya graphic system, the earliest steps of which began as picture-writing, was the natural outcome of a desire to record knowledge made by a people who may be classed as the most intelligent and civilized of the American race. The language they used, monosyllabic and rich in homophones, is in fact quite as unique as the development attained in their graphic art in its progression from thought-writing to a certain degree of sound-writing, which has been denominated ikonomatic (D. G. Brinton; "Essays of an Americanist"), "writing not by things but the sound of the names of things." Scientific research has shown that there is less reason than formerly to doubt Landa's suggestion, and that of more recent authorities, in regard to its phoneticism, which is without doubt of a higher standard than has hitherto been supposed.

Dr. Cyrus Thomas has well said in a recent article (*Science*, Vol. XX., No. 505, pp. 197–201) that ". . . although we may know the chief phonetic element of each part of a compound character, we cannot interpret the whole. This will undoubtedly be true unless there are indications of the minor elements." Want of complete lexicons containing words that correspond to the archaic language of the hieratic and demotic script is also a difficulty which must be considered in the work of interpretation — yet with the almost insurmountable obstacles that exist, it may be said that progress has been made in the work. A study of archaic symbols and ideographs has been made in order to determine, if possible, how certain elements used in the Maya graphic art have been derived — in most cases, we think, from the animate and inanimate forms of nature, or from things invented by man for his necessities. In these researches we must not overlook the superstitious offices of early people in symbolizing ideas — basketry, pottery, and rock-scratchings affording many valuable hints of the changes from the nature-derived elements to the more conventionalized, used ideographically or as phonetic elements, be they chief or minor elements. The figures employed may have been in many cases mere conventionalities, but there is evidence in the work of the Maya scribes that the motives of this convention are based upon primitive realism — for they were but simple-minded children of nature, keen observers of her endless variety of forms, quick to adopt the motive she suggested where it could be utilized to serve a desired purpose.

That these assertions are not the outcome of mere theory we shall give, presently, a list from which we think have been derived what we deem to be phonetic elements of the Maya glyphs. Nature is the source from which have been derived the phonetic elements used by us in endeavors to interpret the Maya glyphs, and it may be said that the results are encouraging; the ideographic suggestion and the chief phonetic element having been obtained, recourse can be made to the "minor phonetic elements" — one analysis being a check to the other.

We have progressed far enough to feel sure that the Maya graphic system is based upon picture-writing, a necessary outcome in the progression of all graphic systems, from thought-writing to sound-writing. The majority of the glyphs, as we find them, whether hieratic or demotic, are associated with ideographs, many of these having combined with them phonetic elements which appear as glyphs or component parts of other glyphs — be they single glyphs or component parts of compound glyphs. An excellent example of an ideo-phonetic design is that of Hun Cimil, the god of the Maya hades (see plate C, Codex Peresianus, or Codex Cortesianus, p. 16). It will be remarked by consulting this first-named Codex, de Rosny's edition, that the abdomen of this figure is composed of the day-signs of Landa, the elements composing which, according to the analyses that we have made, are phonetic. In fact, we have found that sixteen out of twenty of the Maya day-signs, and many of their variants, are phonetic. We firmly believe that they will all prove to be phonetic when future study shall have demonstrated more exact methods of analysis. Between the legs are phonetic elements and the ideo-phonetic head (of a cayman?) to the right of the knee of the figure is connected with the glyph of Cimi. Around the ankles are designs that appear in the Codices, at times, as glyphs. The majority of the components of the head, arms, ornaments of the wrists, and the implements held in the left hand also appear as phonetic elements in Maya script. It is for this reason that the term "ideo-phonetic" has been used for the drawings, as they are composites conveying ideographic suggestions — the ideograph itself being intermingled at times or composed of phonetic elements that appear, as we have said, as the component parts of other glyphs. (See figure of Hun Cimil, pp. 53, 15, Cortesianus; p. 14, Tro., also, ibid, 3, 29, 14, 34.) Hundreds of other examples might be quoted, but as they abound throughout the Maya graphic system this will not be necessary.

The following list will indicate the animate and inanimate forms of nature and inventions of man which, it is thought, suggested certain phonetic elements of the Maya graphic system, viz. :—

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| Sky | Animals | Head | Huts |
| Sun | Birds | Eyes | Houses |
| Wind | Fish | Nose | Idols |
| Water | Reptiles | Jaws | Implements of war and of the chase |
| Lightning | Insects | Mouth | Clothing |
| Earth | Appendages of animals, birds, insects, and crustaceans, etc. | Teeth | Ornaments |
| Fire | | Ears | Pottery |
| | | Tongues | Colors |
| | | Arms | Grinding-stones, etc |
| | | Hands | Tortillas |
| | | Feet | Maize |
| | | Thighs, etc. | Honey, etc. |

At a future time examples will be given of analyses of the Maya glyphs, the ideographic suggestion of the glyph, if any, and the drawings which accompany them, together with minor phonetic elements being considered. To give examples in this article, already longer than intended, will be impossible. The results obtained from the list to which we have assigned certain phonetic values, and used in interpretation, are encouraging — proving to our own satisfaction that minor phonetic elements undoubtedly exist in the Maya graphic system. These minor elements have in many cases been considered as meaningless decorations, component parts of ideographs. Many of the minor elements are so combined together that they are difficult to trace. Errors and omissions of the Maya scribes at times increase these difficulties and require especial study and aptitude for such analyses.

The colors, red, yellow, and black, seem to be used in the Peresianus, with phonetic and ideographic value (see plates xxiii. and xxiv.), and are combined at times with the minor elements of the glyphs. It is probable that colors are also used with a certain ideographic and phonetic value in the other Codices. Interesting combinations are to be remarked in the connection of the consonants with the vowel sounds, Landa suggests *ma, me, mo,* for the phonetic value of a certain glyph, and this method of assigning several phonetic values to a glyph is quite common; determinatives in many cases being used to indicate the value intended. Where these determinatives are wanting it is necessary to try the principal phonetic element through the vowel sounds. The principal phonetic value is, however, generally given by the minor elements of the glyph.

If the system and list of phonetic values adopted by the writer in the interpretation of the Maya glyphs, be correct, it suggests a higher standard of phoneticism than can well be accorded to a people, who, though the most highly civilized of the American races, were, we are to suppose, but an Indian people. Judging

by the testimony of the minor phonetic elements there was more method and arrangement in these than we can expect from a Maya — Indian — scribe, and for this reason the writer is prone to condemn his own work, yet repeated trials with the phonetic list arranged by him have given such good results that he is of the opinion that with careful research some good results may accrue that will be of value to students of Maya and its paleography.

It may be added, in conclusion, that the glyph known to Maya paleographers as that of "The God with the Old Man's Face," has been analyzed — its minor elements suggesting that it is that of Hoobuil-Kanil-Bacub. The suggestion given by the minor elements is "Ho-ka-n-ba-ka." The association of this glyph with "The Bee-Keeper's Narrative" of the Troano, lends a strong probability that the interpretation is a correct one, and that a former analysis attempted was erroneous.

This article is intended to be suggestive. The writer holds himself in readiness to modify any of the statements made, if the contrary be proven, or he finds in the progress of his researches that new evidence obtained proves former suggestions to be erroneous, thus only can we diminish the field of error and enlarge that of the truth.

Mexico, Jan. 30.

## PRELIMINARY NOTE ON THE DISTRIBUTION OF PLACE-NAMES IN THE NORTHERN HIGHLANDS OF SCOTLAND.

BY JOHN GUNN, ACTING SECRETARY, ROYAL PHYSICAL SOCIETY.

NOTHING, at the present day, exhibits in a stronger light the effects of the Scandinavian occupation of the Northern Highlands of Scotland than the frequent occurrence of Norse place-names. And this, it must be remembered, in spite of the fact that the invaders were never permanently able to establish their own tongue as the language of the country, except in the Orkney and Shetland Islands (which form no part of the Highlands) and perhaps in certain areas in the Hebrides. The Celts have always had a wonderful power of assimilating to themselves alien races which come among them, and although subdued and ruled over by the vikings and their posterity down to the present time, caused their conquerors to adopt their language, dress, laws, and customs. Yet the number of places named by the Norsemen and still retaining these names is very remarkable.

As to general distribution, these names are more numerous along the coasts than inland. The vikings did not care to settle far from the sea, where impassable mountains and thick forests, inhabited by a warlike and hostile people, hindered convenient access to the sea. Thus as we retire from the sea-shore the place-names assume a more and more distinctly Celtic character. But even in places where the Scandinavian nomenclature more persistently prevails it is interesting to note how only the larger areas and more striking features of the landscape bear Scandinavian names. A parish, with its streams, estates, local districts, and large farms may bear names derived from the Norse, but those of crofts, burns, pools in the rivers, boulders, etc., have, as a general rule, purely Gaelic designations, many of them, doubtless, dating from a much later period than that of the Norse occupation. In this connection it is somewhat curious to observe how few mountains bear Scandinavian designations; forming bold features in the scenery, most of them must have been well known to the vikings, whose names, if they ever named many of them, have come down to us in so very few instances.

Good examples of the facts above stated may be gleaned from the topography of the county of Caithness, as there the vikings found a surer and more permanent footing than on any other part of the mainland of Scotland. The name, Caithness, is itself compound, but was undoubtedly given by the Scandinavians, and signifies "the headland of the Calaibh," the last-mentioned word being the name of the Celtic tribe which owned the district, and resisted, although unavailingly, the invasion and partial conquest of their ancient possessions. Caithness is divided into ten civil parishes, viz., Thurso, Olrig, Dunnet, Canisbay, Bowes, Wick, Watten, Halkirk, Latheron, and Reay. All these are of Norse origin except the two last mentioned, and all, with the exception of Halkirk, have sea-coasts. Latheron and Reay are Gaelic, and these districts, along with the western portion of Halkirk, were the places in which the aborigines were left to dwell in comparative peace. Yet here, all along the coasts, we find numerous Norse derivatives, such as Skail, Lylester, Forse (occurring also in the form Forso), Berriedale, and many others. In the western Halkirk area, which lies far from the sea, we can only remember two Norse names, viz., Glutt and Rumsdale. In the Scandinavian area, however, we discover the aboriginal element to be remarkably strong. The Gael was, and is, naturally facile in topography, and gave a name to almost every object, natural and artificial, which came under his notice in a fairly permanent form. A constant pool of water, a boulder of peculiar color or somewhat uncommon shape or size, a corner of waste land, a ditch — all were named. He frequently added a word from his own vocabulary to a Scandinavian root, using oftenest *Ach* (a field) or *Bal* (a town or farm) in this connection. Thus, we get such compound forms as Achalipster, Achkipster, in which examples we have, in conjunction, the Gaelic *ach* and the Scandinavian *ster*, both words having the same meaning, and making the names tautological.

These remarks are merely intended as an introduction to a more particular examination of a subject of particular interest and of sufficient importance to have induced Sir Charles Wilson, Director of the Ordnance Survey, to request the coöperation of the Scottish Geographical Society in revising the place-names for new issues of the Survey maps. The council of the society thereupon nominated a committee to undertake the work; and this committee, under the presidency of Dr. James Burgess, C.I.E., is now engaged in an examination of all the place-names in the Highlands, and, where there is any doubt, authoritatively fixing the correct form of spelling.

## NOTE UPON THE ABSORPTION OF SULPHUR BY CHARCOAL.

BY WILLIAM P. BLAKE, SHULLSBURG, WISCONSIN.

IN tearing down some heaps of pyritic zinc ores, where heap-roasting to expel the sulphur from the pyrite had been attempted, a part of the wood used as fuel was found at the bottom of the heap not only carbonized, but portions of it, such as small limbs of trees, and looking like ordinary charcoal, were saturated with sulphur. The original form of the wood and its structure, its grain-rings of growth, bark, etc., seemed to be perfectly retained, but the weight and solidity of the masses at once showed that some change had taken place, and this change it was easy to prove was due to the presence of a large amount of sulphur penetrating every part.

The fragments of this sulphurized carbon are hard and brittle, and break most readily at right-angles to the length of the original tree-limbs. The color is very nearly that of ordinary charcoal, but lacks the lustrous black, having instead a grayish-black shade, and when the compound is cut or scratched with a knife, it exhibits a sub-metallic lustre. Specific gravity 1.60.

In the May number of the *American Journal of Science* Professor W. G. Mixter[1] describes the deportment of charcoal with the halogens, nitrogen, sulphur, and oxygen. He points out the extreme difficulty in obtaining fairly pure amorphous carbon, it so tenaciously holds such elements either occluded in its pores or in combination. His experiments were conducted upon three varieties of amorphous carbon, viz., sugar charcoal, lamp-black, and gas carbon. He found that charcoal after exposure to chlorine retains a considerable quantity at high temperatures; one experiment upon heated lamp-black showing an absorption and retention of from 14.3 to 15.5 per cent, while gas carbon, ignited in chlorine and allowed to cool in a current of dry nitrogen, failed to absorb chlorine. He concurs with other recent writers on this subject that carbon and chlorine do not unite directly, but states that chlorine does combine with carbon at high temperatures when hydrogen is present in the carbon, the hydrogen being apparently replaced by chlorine; for, while gas

[1] Amer. Jour. Sci., Third Series, xlv., No. 269, May, 1893, p. 363.

carbon containing 0.035 per cent of hydrogen does not take up chlorine, sugar charcoal, with 0.07 per cent, does take it up.

The experiments with charcoal and sulphur showed the absorption of from 20 to nearly 47 per cent in charcoal containing much hydrogen and oxygen, while nearly pure amorphous carbon takes up but little sulphur. Professor Mixter regards the sulphur as chemically combined with the carbon, in his experiments, and cites Berzelius in support of this view.

## THE EARTH AS AN ELECTRICAL CONDUCTOR.

BY A. F. MCKISSICK, ALABAMA POLYTECHNIC INSTITUTE, AUBURN, ALA.

STEINHILL, at Munich in 1837, was the first to discover that the earth might be used instead of a return wire, contact being made to the earth at the two ends by means of metal plates sunk in the ground. He discovered this while experimenting on the Nürnberg-Fürther railroad for the purpose of determining whether the track could be used for telegraphic purposes. He noticed that the current passed from one rail to the other and the idea to use the ground as a return circuit occurred to him, which he afterwards found to be perfectly feasible. The earth is almost universally used as the return circuit in telephone and telegraph lines. While it is true that in the former a complete metallic circuit is sometimes found, it is not on account of the failure of the earth to conduct the current but for the purpose of diminishing the induction, caused by the presence of electric light and power circuits.

The earth-plates are made of zinc or copper and are sunk in moist earth, in a spring, or in the bed of a river. It has been generally considered that the earth offers no resistance at all as its cross-section is so large, although its specific resistance may be very high. While the resistance of the earth may be neglected when we have to deal with telephone and telegraph circuits, we must consider its resistance when it is to be used for conducting currents of large volume.

The element of danger to life and property forbids its use as a return in commercial lighting and motor circuits.

In street railway circuits, however, the earth is used partly as a return. It has been found that the earth alone, as a general rule, offers too much resistance, so that it is now almost the universal custom to use in connection with the earth the rails bonded together and also a bare copper wire. I had occasion during the past year to notice very closely this resistance in installing a motor at the experiment station of the A. and M. College of Alabama. I had expected to use the earth as a return, but owing to the very high resistance had to abandon this idea. It was with the idea of finding out how much the resistance of the earth near this motor was, that the following experiments were made.

An earth-pit was dug six feet deep, eight feet long, and two feet wide, at each end of the line running from generator at college to motor at experiment station. This line is by measurement three thousand feet long. A plate of copper, seven by two feet, and a plate of tin of same dimensions, soldered to a No. 0000 B and S wire were used as the earth-plate at each end. The plates were packed firmly with charcoal and iron filings and the pit filled with old iron. The water rose in one of the pits to a depth of two feet. With all connections soldered, the resistance measured by a Wheatstone bridge was found to be 102 ohms. Supposing the earth connection was not a good one at each end of the line, an additional earth connection at each end was made by sinking a large piece of iron in a well. With this additional connection there was no appreciable difference in the resistance. Connections to the earth were then made at different distances from the college by connecting one end of a wire to the overhead wire, the other end soldered and tied to a piece of iron six feet long, driven down flush with the ground. These distances were respectively 500, 1,000, 1,500, 2,000, and 2,500 feet from the college. These connections were made at different times, always removing an earth connection when its resistance had been measured. The resistances in the same order were 307, 567, 153, 707, and 217 ohms. The comparatively small resistances of stations 3 and 5 are probably explained by the fact that they were located near branches (small streams).

From these results we may conclude that the resistance of the earth is a very unknown quantity, and the assumption that the resistance of the earth can be neglected in any soil is an unsafe one when the object in view is to transmit currents without very much loss.

## A VALUABLE FLORIDA DEPOSIT.

BY THOS. R. BAKER, PH.D.

THERE occurs near Bartow, Fla., and at other points as far south as Haines City a geological deposit which has recently been found to be very valuable as a material for covering the sandy side-walks and streets of Florida towns. It is popularly known in South Florida by the name "clay," but consists essentially of sand, clay, and oxide of iron, the proportions of which, determined by chemical analysis, are given in the following table:—

| | Per cent. |
|---|---|
| Moisture | 4.20 |
| Silica | 69 03 |
| Aluminum silicate | 18.21 |
| Iron oxide | 8.53 |
| Calcium carbonate | Trace. |

Geologically considered, the deposit is a sandstone rock, and, although it has to be quarried from its bed, it almost completely disintegrates in the quarrying, and needs no further preparation to fit it for the use to which it is applied. It is of a reddish color, due to the presence of oxide of iron.

The material is simply spread over the side-walk or street to which it is to be applied to the depth of several inches, and then sprinkled with water, and rolled with a heavy roller. After being walked upon and driven over for a short time it becomes very compact, and fully as hard as it is in its native bed.

The most valuable constituent of this material, when used as a covering for roads, is undoubtedly the oxide of iron, which acts as a cement, rendering the material capable of becoming compact and hard. That the iron serves this purpose was verified by removing it from the compound, and subjecting the mixture of the remaining constituents to tests that had been applied to the original material.

The adaptation of this deposit to the improvement of roads was first brought to notice by the South Florida and other railroad companies, who used it for the improvement of railroad crossings, drive-ways about stations, etc., and the first extensive use made of it for streets and side-walks was by the city of Orlando about a year ago. It has given excellent satisfaction in Orlando, nothing having been done for the place for years that has so improved it. It has been the means of converting streets so sandy that travel over them was very slow and difficult into drive-ways over which travel is easy and pleasant. Now, on Orlando streets, vehicles and horses' hoofs have the familiar rattle and thud that are heard when driving over a macadamized road. It is the opinion of those who have studied the subject that geological deposits like the one here described are of very rare occurrence.

## NOTES AND NEWS.

THE next meeting of the Australian Association for the Advancement of Science will be held in Adelaide, South Australia, commencing on September 25th, 1893. The meeting in Adelaide will be presided over by Ralph Tate, F.L.S., F.G.S., professor of natural science at the University of Adelaide. At the time fixed for the meeting, South Australia will be at its best. There is no better time at which to visit Australia than when spring is merging into summer. To naturalists, this time of year is specially attractive, and these may be reminded that at the meeting of the Association they will come into contact with men of like tastes from all parts of Australia. Should visitors wish to prolong their trip, they will do well to visit during the months of October and November the principal objects of interest in the mainland, and in December, January, and February to pass on to New Zealand and Tasmania.

SCIENCE:

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## REPORT ON THE MEMORIAL PRESENTED TO THE SMITHSONIAN INSTITUTION REGARDING AN AMERICAN TABLE AT THE NAPLES ZOÖLOGICAL STATION.[1]

*To the Biologists of the United States:* I have the honor to submit the following report on the Memorial which was circulated last winter, petitioning the Smithsonian Institution to support a table at the Naples Station.

Thirteen copies of the Memorial were sent out. Twelve of these, bearing the signatures of nearly two hundred working biologists, representing about eighty universities, colleges, and scientific institutions, were returned to me, and were presented in person to Professor S. P. Langley, secretary of the Smithsonian Institution.

In reply to the Memorial, the following letter was received:—

SMITHSONIAN INSTITUTION,
WASHINGTON, April 7, 1893.

*Dear Sir:*

I have given careful consideration to the petitions and papers presented by you, and I have decided, in behalf of the Smithsonian Institution, to rent a table at the Naples Zoölogical Station for three years, and have already taken steps to secure it.

I shall be glad to be able to learn the opinions of the representative biologists of the United States in regard to the best administration of this table, and I shall esteem it a favor if, through your mediation, an advisory committee of four persons may be formed; one to be nominated by the president of the National Academy of Sciences, one by the president of the American Society of Naturalists, one by the president of the Americal Morphological Society, and one by the president of the Association of American Anatomists, with the understanding that I may, if need arise, feel at liberty to ask their counsel in regard to the regulations for the use of the table, or as to the merits of applicants for it.

The table will be known as The Smithsonian Table. Publications resulting from its use will bear the name of the Smithsonian Institution, and such of them as are of sufficient importance will probably be printed in the "Smithsonian Contributions to Knowledge."

While the exact conditions will be determined later, I may say, subject to better advices, that it seems to me now that applications for the use of the table should be made to the secretary of the institution, who will probably desire to feel authorized to consult the above-mentioned committee concerning them, whenever, in his judgment, occasion arises for doing so.

If this meets your approval, will you kindly communicate to the president of each of the societies named my request, that he nominate a member of the advisory committee in question?

Very respectfully yours,
S. P. LANGLEY,
Secretary.

Dr. C. W. Stiles.

In accordance with this letter, I communicated with the gentlemen designated and forwarded the following nominations, made by them, to Secretary Langley:—

Major John S. Billings, M.D., U.S.A., nominated by Professor O. C. Marsh, president of the National Academy of Sciences.

E. B. Wilson, Ph.D., professor of zoölogy, Columbia University, nominated by Professor Chittenden, president of the Society of American Naturalists.

C. W. Stiles, Ph.D., zoölogist, Bureau of Animal Industry, U. S. Department of Agriculture, nominated by Professor C. O. Whitman, president of the American Morphological Society.

John A. Ryder, Ph.D., professor of embryology, University of Pennsylvania, nominated by Professor Allen, president of the Association of American Anatomists.

In regard to these nominations, the secretary of the Smithsonian Institution has addressed the following letters to me:—

June 5, 1893.

*My dear Sir:*

I am pleased to receive your letter of 2d instant, in reference to the appointment of members of the advisory committee, with whom I may feel at liberty to consult, concerning appointments for the Smithsonian Table at the Naples Zoölogical Station.

As I understand you, Doctor J. S. Billings, U.S.A., of Washington, is nominated by the National Academy of Sciences; Professor E. B. Wilson of Columbia University, New York, to represent the American Society of Naturalists; you to represent the American Morphological Society; and Professor John A. Ryder of the University of Pennsylvania to represent the Association of American Anatomists.

I am glad to accept the nomination of these gentlemen, and in each case to appoint the nominee a member of the committee; and since you do not name the chairman, I beg that you will, acting provisionally as such, make this statement to each of the gentlemen in question.

I would suggest that it would much facilitate the business in hand, if the chairman of the committee should be a resident of Washington, and be so far authorized to speak for the committee, that he need not consult its individual members on every separate application. I am, sir,

Very respectfully yours,
S. P. LANGLEY,
Secretary.

June 8, 1893.

*Dear Sir:*

I wish to add to my letter written two days ago the statement that I have decided to designate Dr. Billings chairman of the Advisory Committee on the Smithsonian Table at the Naples Station, and yourself as secretary.

Please communicate this fact when you write to the several members of the committee announcing their formal appointment.

Yours respectfully,
S. P. LANGLEY,
Secretary.

DR. C. W. STILES,
U. S. Department of Agriculture, Washington.

Professor Langley has also sent me the following announcement for publication, and a copy of the contract between the Smithsonian and Professor Dohrn, which is here published for the benfit of those who contemplate a trip to Naples.

The secretary of the Smithsonian Institution announces that the Institution has secured a table at the Naples Zoölogical Station for the use of American investigators. Applications for the use of this table will be received at any time, and should be accompanied by credentials indicating that the candidate is qualified to carry on original investigation in some field for which especial facilities are offered at the Naples Station. These credentials should be accompanied by a statement of the history of the candi-

[1] Scientific journals throughout the country please copy this report in full or abstract it, so that it may reach every working biologist.—C. W. S.

date as a student and investigator, together with a list of such original papers as may have been published by him. The application should be also accompanied by a statement of the character of the investigation which the candidate desires to pursue, and the dates between which he wishes to occupy the table.

Appointments will be made by the secretary of the Smithsonian for a specific period, and, in the consideration of the claims of the candidates, the Secretary will probably avail himself of the counsel of an advisory committee of four, representing the National Academy of Sciences, the Society of American Naturalists, the American Morphological Society, and the Association of American Anatomists.

Persons who may occupy the Smithsonian table are expected to make a report at the end of their term of occupation, or every three months in case of long residence at the station. It is expected that due credit will be given to the Smithsonian Institution in any publication resulting from studies carried on at its table, and the "Smithsonian Contributions to Knowledge" will probably be available for the publication of at least a part of the papers resulting from the Naples investigations.

All correspondence should be addressed to S. P. Langley, Secretary of the Smithsonian Institution, Washington, D.C.

STAZIONE ZOÖLOGICA DI NAPOLI.

Entre la "Smithsonian Institution," Washington, et le Professeur Dr. Antoine Dohrn, Directeur de la Station Zoölogique de Naples, a été établi le suivant

CONTRAT.

1. Monsieur le Docteur A. Dohrn met à la dispcsition de la Smithsonian Institution une table d'étude dans les laboratoires de la Station Zoölogique à Naples, aux conditions suivantes et contre l'indemnité qualifieé dans l'article 11 de ce contrat.

2. La table doit être prête à être occupée par le savant nommé par la Smithsonian Institution, dans le terme de huit jours aprés que l'Administration aura été avisée de son arrivée.

3. La table doit être munie des objets énumérés ci-dessous:—

(*a*) Des principaux réactifs chimiques,

(*b*) Des instruments necessaires à la technique anatomique et microscopique,

(*c*) Des accessoires pour le dessin.

Les laboratoires seront dûment pourvus d'instruments et d'appareils plus compliqués qui sont devenus d'usage, pourtant ceux-là se trouveront au nombre de deux ou trois exemplaires, et l'on est tenu de s'en servir en commun.

La Station ne pourvoit pas les tables d'instruments optiques, puisqu'il s'entend que ceux qui viennent y travailler en possèdent de leur propre choix.

4. La table possède un nombre suffisant de petits aquariums pourvus d'eau de mer courante, et devant servir aux expérience que le savant se trouvera dans la nécessité d'entreprendre.

5. Les animaux qui feront l'objet d'étude seront renouvelés aussi souvent que possible et selon que le savant en demandera. On pourra en outre avoir du matériel preparé et conservé selon les méthodes voulues, afin de pouvoir continuer les études commencés à Naples.

6. Le grand Aquarium annexé à la Station Zoölogique sera ouvert gratis à l'occupant de la table, soit pour en jouir, soit pour y faire des études sur les moeurs des animaux.

7. La Bibliothèque de la Station Zoölogique est accessible à l'occupant de la table, dans une salle contiguë aux laboratoires, et peut servir de salle de lecture et à la compilation des manuscrits.

8. Les laboratoires seront ouverts à sept heures du matin en été, et à huit heures en hiver. Dans des cas exceptionnels on poura s'accorder avec l'Administration pour d'autres arrangements, pourtant les employés ne seront pas tenus de tenir les laboratoires prêts avant l'heure indiquée. Depuis le 20 Juin jusqu'au 20 Août les laboratoires seront fermés.

9. L'occupant de la table aura le droit de prendre part aux expéditions de pêche que feront les embarcations de la Station, ainsi que de se faire enseigner les diverses methodes en usage.

10. Les degats commís par l'occupant de la table sur les instruments et utensiles resteront à la charge de d'Administration de l'Institut autant qu'ils ne depasseront pas la sommes de 20 francs.

11. Le présent Contrat aura la durée de trois ans. et la Smithsonian Institution s'engage à payer à Monsieur le Docteur Antoine Dohrn, Directeur de la Station Zoölogique, annuellement et par anticipation la somme de francs 2500 en or (deux mille cinq cents francs en or) pour la table louée dans les laboratoires de la Station Zoölogique.

Signé en double exemplaire.

Washington, June 9, 1893. — Naples, 16 May, 1893.

S. P. LANGLEY, Secretary of the Smithsonian Institution. — PROFESSEUR DR ANTON DOHRN, Directeur de la Station Zoölogique de Naples.

In conclusion, I wish to express my obligations to the signers of the petition for their prompt and hearty support in this matter, which is of great interest to us all.

The Smithsonian Institution has now placed a table at our disposal, and in so doing has rendered to the professional biologists of the country a service which should be appreciated by all, and which will be especially appreciated by those of us who, on account of the non-existence of an American table for many years prior to the establishment of the Davis table, have either been debarred from the Naples Station or have worked there only at the courtesy of foreign institutions or by personal favor of Professor Dohrn. Let us now show our appreciation of Professor Langley's action by seeing that the table is occupied the entire time. I would respectfully suggest that those contemplating making application for the use of the table should do so at as early a date as possible, so that ample time will be given for correspondence and for arranging a proper distribution of the table so that all worthy applicants may be given an opportunity to spend a few months at the station.

Respectfully submitted,

C. W. STILES.

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## ASSOCIATION OF COLORS WITH SOUNDS.

BY B. F. UNDERWOOD, CHICAGO, ILL.

A BLOW on the head often gives rise to luminous sensations (for luminousness is a sensation and not, as is popularly supposed, a thing per se) and, under the influence of the shock, the person seems to see a multitude of sparks. Describing the effect of a fall on the ice, boys say it made them "see stars." Frequently there is great variety and brilliancy of colors thus seen. Vibrations which, affecting the auditory nerve, produce the sensation of sound, in some cases have the power of causing the sensation of luminousness. Indeed, there are persons who, whenever they hear a sound, also perceive a color, one sound corresponding with red, another with blue, another with green, etc. Dr. Nussbaumer, of Vienna, relates that when a child, in playing one day with his brother, he struck a fork against a glass to hear the ringing, and while he heard the sound, he discerned colors. He says that when he stopped his ears, he could tell by the colors how loud was the sound produced by the contact of the fork with the glass. Very much the same were the experiences of the brother. The doctor relates the observations of a medical student in Zurich, to whom notes of music were translated by certain fixed colors, the high notes by clear, the low ones by dull colors.

M. Pedrona, an opthalmologist of Nantes, states that he had a friend who was accustomed to the simultaneous perception of sounds and colors, but he avoided speaking of it, not wishing to be thought strange or to be an object of curiosity or a subject of discussion. At one time a number of persons were repeating a slang expression, which occurred in some popular story, "That is as fine as a yellow dog," applying it in a jocular manner to all kinds of things and actions. One of the company said of another person, "Have you noticed his voice? It is as fine as a yellow dog." M. Pedrona's friend replied seriously and with emphasis, "His voice is not yellow; it is pure red." The downright earnestness with which the remark was made, caused the whole company to laugh outright. "What," said they, "a red voice? What do you mean?" The gentleman had to explain the peculiar faculty which he possessed of seeing the color of voices. When he had done this each person present desired to be informed of the color of his own voice. The voices were charac-

terized as blue, red, green, etc. The joke was on a young man who happened to have a yellow voice.

M. Pedrona says that his friend had perfect sight and hearing and that he was in the best of health. With him a luminous impression seemed to be made before he experienced the sonorous impression. So keen was the chromatic sensitiveness that he knew whether the sound was blue, red, yellow, or of other color, before he could judge of its quality and intensity. He differed in one respect from the Zurich student — he did not perceive a change of color with every modification of tone. A sharp note was only brighter, while the flat one was duller than the natural. The same piece of music played upon different instruments produced different sensations. A melody played on a clarionet was red and on a piano blue. The color was intense in proportion to the energy of the sound. The colored appearances of the sound were perceived on the vibrating body, for instance, on the strings of the guitar or over the keys of the piano. "The seat of color," said the person who experienced these impressions, "appears to me to be principally where the sound is made, above the person who is singing. The impression is the same if I do not see any one. There is no sensation in the eye, for I think of the same color with my eyes shut. It is the same when the sound comes from the street through the walls and partitions. When I hear a choir of several voices, a host of colors seem to shine like little points over the choristers; I do not see them but I am impelled to look toward them and sometimes, while looking toward them, I am surprised not to see them."

This association of colors with sounds is more common than has hitherto been thought by the few persons who have called attention to the phenomena. It has been assumed that the experiences were hallucinations. It is more probable that they result from some connection between the auditory and visual nervous fibres. It is now known that there are motor nerve-centres which perform particular functions, and it will probably be found that near the acoustic centres are also chromatic centres, and that, in such cases as have been described above, they echo to each other. The fibres of the nerve of hearing may thus produce vibrations at different periods of the chromatic fibres.

According to the doctrine of evolution all the other senses have come slowly into existence as so many modifications of feeling. Indeed, hearing and sight, as well as taste, are modes of feeling. Differentiation of feeling has, in the evolutionary processes, corresponded with the differentiation of physical structure. In the lowest forms of life there are no developed and defined parts like the organs of hearing, sight, smell, and none such as in the higher animals make possible variety and sensitiveness through touch alone. "The spider's touch, how exquisitely fine," exclaims Pope. What a difference in the sensation of touch between the speck of living jelly, homogeneous so far as it appears to the eye, and a man with his differentiated structure, his several senses through which

> Soft silence and the night
> Become the teachers of sweet harmony.

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## THE GULL LAKE BIOLOGICAL STATION OF THE UNIVERSITY OF MINNESOTA.

BY CONWAY MACMILLAN, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.

THE establishment, during the present season, of an inland biological station, marks a new epoch in Americal biological instruction. While several excellent marine stations have already been organized both upon the Atlantic and Pacific coasts, and most recently upon the Gulf of Mexico, up to the present time — so far as known to the writer — there has been no inland station provided for the free use of American investigators. The great need of such a station, well equipped for every kind of biological work, has long been pressing, and it is now hoped that a foundation has been secured upon which to build as broadly as possible for the best interests of American biology. The establishment by individual enterprise of such a private laboratory as the well-known one at Milwaukee, has served to accentuate the need of an inland station, access to which might be general. The University of Minnesota proposes now to offer such a station, and a party of twenty, representing at least four different institutions, begin work early in June. The station is situated upon one of the deep bays of Gull Lake, in Cass County, Minnesota. This lake is about eighteen miles from Brainerd, and lies in the pine-belt of central Minnesota. It is an attractive sheet of water, about twelve miles in length and four miles in width, with irregular coast-line, and surrounded by hills, meadows, marshes, promontories, swamps and smaller lakes. With a great diversity of conditions in its vicinity and in its own waters, it is an excellent spot for general inland biological work. Its situation, too, as one of the innumerable lakes which form the general reservoir in which the great central river of the continent takes its rise, adds an interest to its study. As a region for the investigation of the various problems of isolation it is peculiarly fine. Many of the hundreds of lakes in Cass county were originally united, but are now separated from each other by permanent divides. In such waters, comparative study of the plankton, pelagic and limnetic groups of organisms can not but be productive of new and important results. Both zöologically and botanically, Gull Lake and its tributary country promise a rich field of investigation.

The laboratory buildings form a cluster of cottages on the brow of an abrupt hill, lying toward the east. The cottages number five, and in addition there is a larger building, two stories in height, with kitchen and dining room and sleeping apartments. These buildings have been placed at the disposal of the biological departments of the University through the courtesy of the Northern Mill Company of Minneapolis. Until recently, they formed a supply camp and headquarters for the company while it was cutting timber in the vicinity of the west shores of Gull Lake. The cottages are neatly plastered and papered, and form an altogether admirable series of buildings for a summer station. From Brainerd, the laboratories are reached by the Brainerd and Northern Minnesota Railway, the officials of which have assisted much in the development of the plan of establishment.

Apparatus of all necessary sorts has been shipped from the University, and the investigators in the station will be given every facility in the power of the University to pursue their work under favorable and inspiring conditions. Boats have been put upon the lakes, and a steamer belonging to the Northern Mill Company has been placed at the disposal of the station for extended trips about Gull Lake itself. Dredges, nets, seines, collecting apparatus of all sorts, both aquatic and terrestrial, have been shipped to the station, and are in constant use. Abundant opportunity for collection may be secured, and those who desire are permitted to give their principal attention to such work, while others are engaged more particularly upon lines of special research.

The direction of the laboratory is under the professors of botany and animal biology in the University of Minnesota, and thus broadly organized there is no danger that the name will be a misnomer for a special zöological or botanical station. The plan of establishment contemplates the largest and most modern development, and equipment for work in experimental embryology, oecology, plankton study, etc., will be freely provided, as it is demanded.

To the botanists and zöologists of America it is not necessary to explain or defend the establishment of such a station. Modelled, as it is, somewhat upon the lines of its old world predecessor, Plön, it hopes by its connection with one of the state universities to offer its advantages to a constantly increasing circle of investigators, at a cost much below that which might be possible for any private institution of kindred nature. While still in an inchoate condition, when the ultimate possibilities and expectations are considered, it will begin with a relatively large corps of workers, under conditions highly favorable for a successful continuance. It will, during the first season, from June 1st to September 1st, welcome any serious student who may come to its doors. While its accommodations are not unlimited, it can care for such as give due announcement of their coming, and the directors will be glad to enter into correspondence with those contemplating a visit. The address of mail should be as follows: Stony Brook Landing, care of Northern Mill Co., Brainerd, Minn.

## NOTES ON THE POLLINATION OF PLUMS.

BY L. H. PAMMEL, AMES, IOWA.

SOME years ago while making a few random examinations of the cultivated DeSoto Plum (*Prunus Americana*, Marshall) I found to my surprise that the flowers were not all perfect, although described as such. Many flowers have since been examined and I have never failed, in some individuals at least, to find this character well pronounced.

In all cases examined the suppression was in the direction of the pistil. The stamens in all cases were well developed. In these imperfect flowers the pistil is short, scarcely as long as the calyx tube. In the Rollingstone the pistil is entirely absent in many cases.

To see how generally the pistils were rudimentary, a number of counts were made on branches selected at random on several trees.

**First Tree.**

| | Perfect. | Imperfect. |
|---|---|---|
| First branch, | 10 | 2 |
| Second " | 14 | 4 |
| Third " | 17 | 5 |
| Fourth " | 7 | 2 |

**Second Tree.**

| | Perfect. | Imperfect. |
|---|---|---|
| First branch, | 15 | 2 |
| Second " | 10 | 6 |

**Third Tree.**

| | Perfect. | Imperfect. |
|---|---|---|
| First branch, | 0 | 36 |
| Second " | 16 | 0 |

These imperfect flowers also occur in the Pottawattamie, but not so commonly as the Rollingstone and DeSoto. I thought at first that these imperfect flowers might be due to the improvement of the variety under cultivation, but on examining some seedlings along an old fence I found that imperfect flowers also occurred. Of the enormous number of perfect flowers produced on a single tree a small percentage only develop into plums. They are undoubtedly in many cases fertilized but for want of nutrition fail to mature.

The flowers of *Prunus Americana*, in absence of cross pollination, are undoubtedly close pollinated. To test the matter of close fertilization, about 150 flowers were covered with paper bags. Of these fifty set. Between twenty-five and thirty flowers were castrated and pollen applied from other flowers of the same plant with the result that one-third set. Considering the circumstances under which they were made it is a fairly good showing.

I was much interested this spring to notice that some forms of *Prunus domestica* (Moldavka Plum) are proterogynous. The pistil in some cases protrudes while the flowers are still more or less closed. In other forms of *Prunus domestica* grown on the college grounds the pistil matures simultaneously with the stamens. This latter condition agrees with Hermann Müller's[1] observations, who says of *Prunus domestica, P. avium* and *P. cerasus*, "anthers and stigmas ripen simultaneously and spread apart out of the flower." *Prunus padus*, L, and *P. spinosa*, L, according to the same authority, are proterogynous.

The *Rosaceæ* constitute an interesting order of plants, although many of them show adaptations for cross-pollination, they may, at the same time, in absence of cross-pollination, be self-pollinated, not, however, in all cases. Strawberry growers are only too familiar with the failure that results when only one variety is set out.

This tendency to separation of sexes is well marked in widely separated orders and has been admirably discussed by Darwin,[2] who says: "There is much difficulty in understanding why hermaphrodite plants should ever have been rendered diœcious." "We can, however, see that if a species were subjected to unfavorable conditions from severe competition with other plants, or from any other cause, the production of the male and female elements and the maturation of the ovules by the same individual might prove too great a strain on its powers, and the separation of the sexes would then be highly beneficial." As stated in a previous paragraph, many plum flowers are staminate in function as the fruit never develops. This being the case, it would seem an advantage for the pistil to become abortive and in some cases entirely suppressed. May it not be a step in a direction to prevent self-fertilization, which seems to occur quite commonly in some members of this order, or is it the direct action of climate as Darwin thought to be the case in the strawberry?

[1] "Fertilization of Flowers," English translation, p. 222.

[2] "The Different Forms of Flowers on Plants of the Same Species," p. 278, D. Appleton & Co., New York.

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## LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

*On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.*

*The editor will be glad to publish any queries consonant with the character of the journal.*

### Total Heat Received by a Planet.

IT may be as well to call attention to the shortest method of treating what seems to be the principal point at issue in the articles on "Sun-Heat and Orbital Eccentricity" and on "The Mean Distance of the Earth" in recent issues of *Science*.

We have simply for the amount of heat, $dh$, received by any planet in our system by radiation from the sun, in the infinitesimal time $dt$, on a definite area, say a square foot, of its vertically exposed surface,

$$dh = \frac{c}{r^2}\, dt,$$

in which $c$ is a constant depending on the absolute radiation of the sun, which we suppose to be always the same.

But we have

$$dt = \frac{r_2\, d\,\theta}{k\ \sqrt{p}},$$

in which $dt$ is expressed in terms of the day, $d\,\theta$ in the usual way, so that $180^\circ = \pi$; $k$ being the Gaussian constant, depending on the mass or absolute attractive force of the sun, and $p$, the semi-parameter, $= a\,(1 - e^2)$.

Strictly, we must understand by $k$ the Gaussian constant $0.017202 +$ multiplied by $\sqrt{1+\mu}$, in which

$$\mu = \frac{\textit{mass of planet}}{\textit{mass of sun}}.$$

We have then

$$dh = \frac{c}{k\ \sqrt{p}} d\,\theta,$$

and for the total heat received by radiation on the definite area in one revolution,

$$\frac{2\,c\,\pi}{k}.\ \frac{1}{\sqrt{p}}.$$

Now the major axis being supposed constant, $\sqrt{p}$ is proportional to the minor axis. If then the eccentricity varies in a planetary orbit, the major axis remaining constant, the quantity of heat received by the planet in one revolution by radiation from the sun is inversely as the minor axis, if the size and mass of the planet and the mass and absolute radiation of the sun remain unchanged. REV. GEO. M. SEARLE.

Catholic University, Washington, D.C.

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### A Peculiar Occurrence of Beeswax.

AMONG the heterogenous collections of materials that are continually arriving at the National Museum for the purpose of identification, there were received some weeks ago, from Portland, Oregon, samples of a material closely resembling, if not identical with beeswax. Such it would have unhesitatingly been pronounced but for certain stated conditions relating to its mode of occurrence.

The material as received is in the form of (1) nodular, somewhat rounded masses, the largest perhaps the size of a goose egg; (2) in elongated cylindrical forms sometimes incompletely perforated, longitudinally, and (3) as rounded grains forming one of the constituents of a loosely coherent, silicious sandstone. The material is of a grayish color on the outer surface, indicating oxidation, but interiorly it has all the characteristics of genuine beeswax, both as regards physical conditions, color, smell, fusing point, and conduct towards chemical reagents.

In the letter accompanying, the wax is said to be found in masses of all sizes up to 250 pounds weight; that it occurs imbedded in the sand, being found while digging clams at low tide, and at a depth of 20 feet below the surface when digging wells. The material has been traced for a distance of 30 miles up the river.

Tradition has it that many hundred years ago a foreign vessel, (some say a Chinese junk) laden with wax, was wrecked off this coast. This at first thought seems plausible, but aside from the difficulty of accounting for the presence in these waters and at that date, of a vessel loaded with wax, it seems scarcely credible that the material could have been brought, in a single cargo, in such quantities, nor buried so deeply over so large an area. In a fragment of the sandstone above alluded to, the wax occurs in disseminated grains less than half the size of a pin's head and in such abundance that when ignited the stone falls away to a loose gray silicious sand. My correspondent states that the material has been mined by the whites for ever 20 years, but not to any great extent excepting the last 8 or 10 years, during which time many hundred tons have been shipped to San Francisco and Portland, and sold at the rate of 18 cents per pound.

Concerning the accuracy of the account as above given the present writer knows nothing. It is here given in the hope of gaining more information on the subject.

GEORGE P. MERRILL.

U. S. National Museum, Washington, D.C., June 9.

### Books for Children.

WILL some specialists in natural history recommend some really satisfactory cheap books suitable for the guidance of children, ten years of age, in their rambles through the fields and woods? Most of the cheap books that I have seen do not give the necessary details for identifying specimens, and yet the naming of what is seen or collected is necessary for arousing enthusiasm in studying the forms of life. Some of the topics which I am inquiring about are as follows:—

The naming of free birds from their size, plumage, song, and habits; and the place and manner of constructing nests and habits of nesting. The naming of trees and shrubs from their bark and leaves. The naming of weeds and flowers found growing wild in the east-central part of the United States. The naming of land-snails, beetles, butterflies, and moths, and their habits.

Perhaps the Agassiz associations have made out lists of the specimens to be found in the various regions of the United States. If this has been done, I have not happened to see any notice of it.

In this connection, I wish to mention the work done by my own teacher in a suburban school at Cincinnati more than twenty years ago. The superintendent of the school, Mr. A. G. Weatherby, afterwards a professor in the Cincinnati University, was an indefatigable collector in various departments of natural history, and his enthusiasm was communicated to his pupils so strongly that there was hardly a boy in his school-room who had not a collection of local moths, land-snail shells, and fresh-water clam-shells. We had them all properly prepared and Mr. Weatherby named them for us; but we learned the localities in which different species were to be found through the broad experience of our teacher, and not from books. In fact, although many of our class of boys had almost complete sets of local snail-shells, and all named, yet I doubt if any of us ever looked into a work on conchology. I do not know whether any of Mr. Weatherby's early pupils have since become professional naturalists, as a result of his teachings, but I do know that the collecting excursions made under his direction were most beneficial as a means of sharpening our powers of observation, and added immensely to the happiness of boyhood.

I am sure that many readers of *Science* will be glad to get information such as I have asked for, as very few parents are able to help their children in classifying and naming the "finds" that they are continually bringing in from the fields.

FRANK WALDO.

Princeton, N.J., June 5.

### Worms in the Brain of a Bird.

IN your issue of June 2 is a communication "Relative to Worms in the Brain of a Bird."

Your correspondent will find, by consulting "Fresh-Water Shell Mounds of the St. John's River, Florida," by Professor Jeffries Wyman, page 7, foot-note, an account of a parasitical worm commonly found in the brain of the "snake bird," or water turkey.

CLARENCE B. MOORE.

Philadelphia, June 6.

### Note on a Supposed New Endogenous Tree from the Carboniferous.

IN the May number of the *American Geologist* (Vol. XI., 1893, pp. 285, 286, Pl. VI.) I find a short paper by Mr. H. Herzer on "A New Tree from the Carboniferous Rocks of Monroe County, Ohio," in which he describes, under the name of *Winchellina fascina*, a new genus and species. The discovery of a new genus of plants in the Carboniferous, a formation of which the flora is now so very well known, is of itself of considerable interest, but when we learn that it was an endogenous tree the interest deepens, and the discovery, if true, would be the most important addition to our knowledge of the ancestors of this great group of plants that has been made in many years.

The Carboniferous has been called the age of ferns, from the great abundance and high state of development enjoyed by this class of plants in this part of the Paleozoic system. Several supposed endogens have been reported from the Paleozoic, but they have sooner or later been shown to belong to other vegetable classes, and at the present time there is not a single form accepted by paleobotanists as belonging to this age. In fact it is not until well up into the Mesozoic that undoubted endogens made their appearance. This is, of course, negative evidence, but it is so strong that it requires the most positive and convincing evidence to prove their earlier ancestry.

The literature relating to the internal structure of plants of the Paleozoic is now very extensive, and from a careful study of this it appears almost beyond question that the supposed new endogenous tree is a fern-stem of a well-known type. I have not seen the original trunk or sections cut from it, but, judging from the somewhat imperfect description and figures, it is impossible to see any differences of importance between *Winchellina fascina* and *Psaronius cottæ* corda[1] from the Permian of Saxony. It also approaches very closely to *Tubiculites* (*Psaronius*) *relaxato-maximus*[2] Grand'Eury, a fern-stem from the Carboniferous of central France. The cell-bundles described by Mr. Herzer are quite unlike those of any monocotyledon with which I am familiar, but agree well with those described for fern-stems from the older rocks. The reference of this plant to the ferns is also quite in accord with facts that have long been known, for Dr. Newberry recorded the genus *Psaronius* as occurring "in great abundance" in the Carboniferous rocks of Ohio more than forty years ago.[3]

The genus *Psaronius* is a somewhat comprehensive one, and a number of more or less satisfactory genera have recently been separated out of it by Williamson, Renault, Zeiller and others, and it is possible that when the fossil under discussion is more

[1] Stenzel, Ueber die Staarsteine, Jena 1854, p. 867, Pl. xxxv., Fig. 1.

[2] Flore Carbonifère du Dépt. de la Loire. Mem. l'Acad. d. Sci., xxiv., 1877, p. 102, Pl. x., Figs. 3, 4.

[3] Annals of Science, No. 8, Feb. 1, 1853, p. 97.

thoroughly studied it will be found to belong to one of these re cently differentiated genera. F. H. KNOWLTON.

U. S. National Museum, Washington, D. C.

## Mean Values.

MISS PORTER'S kindly criticism (*Science*, June 2) of one point in the article, "Sun-Heat and Orbital Eccentricity" (*Science*, Apr. 28), gives occasion to say a work in regard to mean values. Since the mean value of $n$ quantities is the arithmetic mean of their sum, it would appear at first glance as if the term were a perfectly definite one; but if the quantities to be averaged are successive values of a function of some variable, then clearly their magnitudes depend not only on the nature of the function, but also on the law of variation of the fundamental. Thus, suppose we have the isotherm, $pv = c$, and wish to know the average pressure between the volumes $v = v_1$ and $v = v_2$. It is necessary to make some assumption in regard to the variation of $v$. If its increments are supposed equal, we understand by the "mean value" of the pressure the average of the pressures corresponding to the values of $v$. If the volume is assumed to depend in turn on some other variable in such a manner that the abscissa-increments are not equal, the mean value will now be the average of the new series of pressure-ordinates corresponding to the series of values of $v$ arising under the second assumption. Evidently these two means will in general be unequal, but one is just as properly the "real average" as the other. The formula for mean value may be derived by a method even simpler than the usual analytical one as given by Williamson and Todhunter. Let it be required to find the mean value of $y$ where $y = f(x)$ and $x$ is an equicrescent variable. If $y = f(x)$ be treated as a curve referred to rectangular axes, $\int_a^b f(x)\,dx$ is the expression for the area, $A$, bounded by the $X$-axis, two ordinates, and the portion of the curve intercepted between the bounding ordinates. Let $A = A'$, where $A'$ is a rectangle whose base equals the base of $A$. Then the altitude of $A'$ is the average of the ordinates in $A$. For let

$$\frac{y_1 + y_2 + \ldots\ldots y_n}{n} = y_0,$$

the average of the series of ordinates.

Then $y_1 + y_2 + \ldots\ldots = y_0 + y_0 + \ldots.$ on to $n$ terms.

Multiplying by $\triangle x$ and summing,

$$\Sigma\,(y_1 + y_2 + \ldots.)\,\triangle x = \Sigma\,(y_0 + y_0 + \ldots.)\,\triangle x;$$

or, making $n$ indefinitely large,

$$\int_a^b y\,dx = y_0 \int_a^b dx = y_0\,(b - a).$$

But $$\int_a^b y\,dx = A, \text{ hence } y_0\,(b - a) = A',$$

and, since $b - a$ is the base of the rectangle, $A'$, $y_0$ is it saltitude.

For example, let it be required to find the mean pressure between the volumes $v_1$ and $v_2$. If the isotherm is $pv = c$, the area, $A$, in this case becomes

$$\int_{v_1}^{v_2} \frac{c}{v}\,dv = c \log\left(\frac{v_2}{v_1}\right);$$

its base is $v_2 - v_1$, hence the mean pressure is

$$\frac{c}{v_2 - v_1} \log\left(\frac{v_2}{v_1}\right).$$

This conception of mean values may be readily employed when a curve is expressed in polar coördinates. If $r = f(\theta)$, let $x$ be written for $\theta$ and $y$ for $r$. The Cartesian equation thus arising furnishes a curve which sustains peculiar relations to the original polar curve. The radii-vectores are taken out of their fan-shaped arrangement and placed equi-distant and parallel, with their extremities on the comon line, the $X$-axis. The pole may be viewed as having developed into this axis, whilst a circle of unit radius with pole as centre has developed into a straight line parallel to the axis, the radii-vectores keeping their normal position with respect to the circle. In finding the mean value of the radius-vector of an ellipse, $d\theta$ being constant, the figure $A$ has three rectilinear sides: $x = 0$, $x = \pi$, and the $X$-axis. Its fourth side is the curve,

$$y = \frac{a\,(1 - e^2)}{1 + e \cos x}.$$

The base of the figure is $\pi$; hence the mean value is

$$\frac{1}{\pi}\int_0^\pi \frac{a\,(1 - e^2)}{1 + e \cos x}\,dx = a\,\sqrt{1 - e^2}.$$

It will be seen that the area-method serves only when the ordinates are equally distributed throughout the area $A$. In the dynamical problem of the earth's mean distance from the sun it is not $\theta$ (or $x$) which is the equicrescent variable, but $t$, the time. $A$ must therefore be taken equal to

$$\int_{t_1}^{t_2} r\,dt,$$

for which $r = f(t)$ must be given; but, as is well known, the equation expressing the relation between $r$ and $t$ is transcendental and cannot be written in the form $r = f(t)$. Recourse must therefore be had to other devices for finding the mean distance when the problem is rendered kinematical by taking Kepler's second law into account. ELLEN HAYES.

Wellesley, Mass.

## Iron and Aluminium in Bone Black.

WILL you kindly, in your next issue, print the following corrections to my article on "Iron and Aluminium in Bone Black," which has just reached me.

Page 300, first column. In twentieth line (from the bottom of page), after the word "permanent," insert, *and boil*. In nineteenth line (from bottom of page) remove the first two words: "and boil."

In twelfth line (from bottom of page) insert a decimal point between 5 and 0 at end of this line, for the figure must read 5.0 and not 50 grammes.

Page 301, first column. In twentieth line (from bottom of page) transpose after "iron." Instead of "aluminium, or the phosphate" then should stand: or the aluminium phosphate predominates.

J. G. WIECHMANN.

New York, June 7.

## Estimated Distance of Phantoms.

IN *Science* of May 19, p. 269, Mr. Bostwick mentions the familiar experiment of binocular combination of regular patterns, such as a tessellated pavement or figured wall-paper, by means of ocular convergence, and states that in his case, although the figures of the phantom thus formed appear smaller, yet contrary to the statements of all other writers they do not appear nearer but farther off than the real object. This seems to me inexplicable if the phantom is really distinct.

As I have very unusual facility in making such binocular combinations, I will very briefly describe an experiment of this kind. I stand now looking down on the tesselated oil-cloth covering the floor of the library. By ocular convergence I slide the two images of the floor over one another in such wise as to combine contiguous figures. After perhaps a brief interval of indistinctness, the pattern appears with perfect clearness at half the distance of the floor and the figures of the pattern of half the real size. The sense of reality is just as perfect as in the case of a real floor at that distance. It seems to me as if I could rap it with my knuckle. Taking now this phantom as a real object, by greater convergence the plane can be brought up higher and higher, until by extreme convergence it is brought within three inches of the root of the nose and seen there with the greatest distinctness in exquisite miniature, the figures being only one-quarter inch in diameter. By relaxing the convergence a little, the phantom-plane may be dropped and caught on lower and

lower levels until it falls to its real place on the floor. The combination beyond the plane of the object, and therefore with figures enlarged, is also easy if the figures are small, but never quite so easy as combination on the nearer side.

These phenomena are as easy to me as any ordinary act of sight. No device of any kind, such as use of pencil or finger to fix the point of sight is at all necessary. I can watch the double images approach, combine, pass over, combine with the next figure, etc., with the greatest ease and certainty. Moreover, the sense of reality and of exact distance is as perfect as that of any other object.

In young normal eyes great difficulty is often experienced in getting this perfect perception of distance because the phantom is not perfectly clear. The reason is this: The two adjustments of the eyes, the axial and the focal, are invariably associated in every act of sight. Therefore, in the experiment the eyes are accommodated to the point of ocular convergence, i.e., the distance of the phantom. But the light comes from a greater distance, viz., from a real object—the floor. The retinal image, therefore, is not distinct and the figures are blurred. I no longer, now, suffer from this difficulty, because I have become presbyopic, and have, therefore, lost the power of accommodation. The clearness of the phantom is perfect almost immediately. When I was younger, there was always a considerable interval before the phantom became clear. The clearing up was the result of a dissociation of these two consensual adjustments. While the axial adjustment remained adapted for the distance of the phantom, the focal adjustment (accommodation) was changed to the distance of the real object. Now this dissociation of two adjustments so invariably associated in every act of sight, is difficult for most, and impossible for many persons. But until this dissociation is effected and the phanton becomes perfectly clear, the sense of reality, and especially the perception of distance, will be imperfect and vacillating. The use of glasses adapted to distinct vision at the distance of some one of the possible phantoms will make that particular phantom clear.

Now this clear perception of the distance of a phantom, nearer and smaller in proportion to the degree of ocular convergence, is, of course, not peculiar to me. All writers on the subject record the same result. All my pupils who succeed at all in binocular combinations get the same result. I am sure I have tried hundreds, I might almost say thousands, and always with the same result. This result is, therefore, normal and in complete accord with the laws of vision. For near objects, there are two modes of estimating distance, viz., by axial convergence (binocular perspective) and by accommodation (focal perspective). Now, of these two, the former is by far the more exact, and therefore takes control of judgment of distance if the two are not in accord. This is proved by naked-eye combination of ordinary stereoscopic pictures by ocular convergence. In such cases, we have the phenomenon of inverse perspective. The judgment of relative distance by axial convergence completely reverses the real relative position of objects. Binocular perspective overrides every other form of perspective, whether focal, or mathematical, or aërial, and comes out victorious in spite of the absurdity or even impossibility of its results.[1]

Now, in the case of phantoms, axial convergence fixes the distance. But this fixes also the size; for the apparent size of anything is a product of the retinal image multiplied by the estimated distance. The size of the figures will be small in proportion to the nearness of the phantom. This is in exact accord with the laws of vision. But Mr. Bostwick says, that in his case the figures seem smaller and yet more distant than the real object. He explains this, if I understand him aright, by the fact that in the dissociation of the axial and focal adjustments, while most persons follow the axial, he follows the focal adjustment, in estimating distance. Near objects require greater accommodation; but there is no such accommodation in this case, therefore the objects judged by this test will not seem nearer. But, again, since

[1] If anyone is specially interested in this subject, he will find it fully treated in my little volume, entitled "Sight," volume 31 of the International Scientific Series.

CALENDAR OF SOCIETIES.

**Appalachian Mountain Club, Boston.**

June 14.—Miss Lucy A. Putnam, An Ascent of Adam's Peak, Ceylon; Henry Lambert, Forests and Forestry in America and Europe.

they seem smaller, and since distant objects also seem smaller, they will seem more distant.

There are two objections to this explanation. 1. The accommodation is for the distance of the real object, as is proved by the distinctness. Why, then, should the object seem farther? 2. Again, distant objects seem smaller only because their retinal images are smaller; but this is not so in the case under consideration.

In justification of his view, Mr. Bostwick says that "in monocular vision an object appears distant or near according as the eye is fixed respectively on something nearer than it or something beyond it." I am familiar with the fact here referred to, but in this case the appearance of greater or less distance is so imperfect that it can hardly be called estimate. It may seem farther or nearer almost at will. It is a matter of fancy, not a sober certainty of rational judgment. In fact, there is no ground for forming any judgment.

Although Mr. Bostwick speaks of his estimate of the distance of the phantom as "distinct," yet I cannot but think that, for want of complete dissociation of the axial and focal adjustments the image is not quite sharp; and that, if he got the same sharp, realistic image which I get, he would see the distance as I see it. Of course, there is no disputing about how things seem to different observers any more than there is about tastes; but nevertheless, there are some things which are normal and reducible to intelligible law, and some not. Mr. Bostwick's case may be abnormal, but I think probably not. I well know how illusive binocular phenomena are. He will, I am sure, pardon me for thinking that with more practice in experiments of this kind he will come to see things as others see them.

JOSEPH LECONTE.

Berkeley, Cal., May 27.

### A Rain of Fishes.

DURING a recent thunder-storm at Winter Park, Fla., a number of fish fell with the rain. They were sunfish from two to four inches long. It is supposed that they were taken up by a water-spout from Lake Virginia, and carried westward by the strong wind that was blowing at the time. The distance from the lake to the place where they fell is about a mile.

THOMAS R. BAKER.

## AMONG THE PUBLISHERS.

MACMILLAN & CO. have published a brief biography of the late English anatomist, William Kitchen Parker, written by his son, T. Jeffery Parker. It begins with an account of his birth and early life on his father's farm, and then of his schooling and his apprenticeship, first to an apothecary and afterwards to a surgeon. With his strong inclination for biological studies, it was natural that he should choose medicine as his profession; but it is evident, as indeed his biographer admits, that he had no great love for his profession and only moderate success in the practice of it His prime interests in life, apart from his family, were two things not often found in conjunction at the present day, science and Wesleyan religion; and he seems to have been equally devoted to both and to have found no incongruity between the two. In biology he was largely self-taught; but a few discerning friends saw that he was capable of important original work, and assisted him in the prosecution of such work. He became a member of the Zoölogical Society and afterwards a fellow of the Royal Society; but the position that proved the most useful to him was the Hunterian professorship of anatomy and physiology in the Royal College of Surgeons, because it not only gave him the opportunity to lecture on his favorite subjects, but also added to his otherwise moderate income. His principal scientific work, his researches on the skull, is described at some length in this book, and there are briefer notices of his other studies and a bibliography of all his published works. His principal fault as a scientific writer, his son thinks, was his complicated style; his topics being arranged in a disorderly way and his sentences hastily constructed. Yet biologists will doubtless echo the words of the Royal Society that he was "an unworldly seeker after truth . . . whose beneficent influence will ever be felt in a wide-spreading and advancing science."



### Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale.—Wheatstone Bridge wire, made to order, new and unused. Price, $10. W. A. Kobbe, Fortress Monroe, Va.

For sale or exchange.—One latest complete edition of Watt's Dictionary of Chemistry, in fair condition; one thirty volume edition (9th) of Allen's Encyclopædia Britannica, almost new. Will sell cheap for cash or will exchange for physical or chemical apparatus. Address Prof. W. S. Leavenworth, Ripon College, Ripon, Wis.

Exchange.—One celestial, one terrestrial globe, one lunatettis and charts, celestial maps, diagrams and ephemeris from 1830 to 1893, astronomical works, all in good condition. Will sell cheap or exchange. Make offer. C. H. Van Dorn, 79 Nassau St., New York.

The Rev. A. C. Waghorne, New Harbor, Newfoundland, wishes to sell collections of Newfoundland and Labrador plants, all named by competent botanists. He is going on a missionary journey along the Labrador coast, from the middle of July till October, and in return for much needed aid towards (Episcopal) Church purposes in that region, will be glad to be of service to any botanists who may write to him. Letters posted in the U. S. up to July 1 will reach him at the above address, and if posted later will be forwarded.

For sale.—J. D. Dana's Report on Crustacea of the U. S. Exploring Expedition under Charles Wilkes. Text and plates well bound in three volumes, half morocco, $75. Samuel Henshaw, Boston Society of Natural History, Boston, Mass.

For exchange—I wish to exchange cabinet skins of Californian birds or mammals for any book on the following list, books if second-hand to be in good order. Manual of Vertebrates, fifth edition, D. S. Jordan; Nests and Eggs of North American Birds, Oliver Davie; Marine Mammals of the West Coast of North America, C. M. Scammon; The United States and Mexican Boundary Survey, Vol. II., Zoology, S. F. Baird. F. Stephens, Witch Creek, San Diego Co., Cal.

Minerals for exchange—John Holl. Rollo, Wilmington, Delaware.

For sale or exchange.—Johnson's Universal Cyclopædia, 8 vols., ed. 1888. Binding, half-morocco. Will sell cheap for cash or would exchange for typewriter. Address W. J. McKom, Mason, Mich.

I have 500 microscopic slides to exchange in lots to suit. Want Kodak, first-class field-glass or scientific books. A. C. Gruhlke, Waterloo, Ind.

### *Wants.*

WANTED.—Second-hand copy of Ehrenberg's Radiolaria, Berlin. 1875. Selected diatom slides, cash or both in exchange. D. C. Lewis, M.D. Skaneateles, N. Y.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y.

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinae in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi*, *cyrtonyx montezumae*, *deudragapus franklini*, *lagopus welchi*, *tympanuchus cupido* and *pedioecetes phasianellus*. Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3922 Fifth Avenue, Pittsburgh, Pa.

A COMPETENT TEACHER of botany in college or university is open to engagement. Address L., Box 86, Rochester, Mich.

CAN any one inform me as to the age to which cats have lived? I have one twenty years old. Edward D. Webb, 132 W. Eighty-first St., New York

WANTED — Second-hand. Foster's Physiology, Balfour's Comparative Embryology, Claus & Sedgwick's Zoology, Flower's Osteology of Mammalia, Vine's Physiology of Plants. Please state editions and prices asked and address Richard Lees Brampton, Ontario, Canada

A GRADUATE ENGINEER will give instruction, evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal. References furnished. C. S. H., 102 Tribune Building, New York.

# QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, al though this query has been published far and wide among electricians.

First inserted June 19, 1891. No response to date.

**N. D. C. HODGES, 874 BROADWAY, N. Y.**